

RECENT TRENDS IN SALMONELLA AND SHIGELLA IN NEW YORK CITY AND AT KINGS COUNTY HOSPITAL

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NEW YORK CITY is unique among metropolitan areas in that salmonellosis has been a reportable disease since 1958. Because virtually all salmonella isolates are serotyped at the laboratories of the New York City Department of Health, virtually all those identified are reported. Similar reporting mechanisms exist for shigella, though their serologic species identification is done at the level of the individual local laboratory.

Review of the past 10-years' experience suggests that there have been, and continue to be, major changes in the frequency of salmonella and shigella serotypes, their antibiotic resistance, and the frequency of their isolation. These changes seem to be a response to similar shifts in the nature and frequency of the disease produced by these organisms. We have reviewed the serotypes of salmonella and shigella reported to the Bureau of Preventable Diseases over the past 10 years, and, to indicate how this is reflected at the local level, similar information has been presented regarding shigella and salmonella isolates identified at Kings County Hospital, the major municipal hospital in central Brooklyn, and the largest hospital of its kind in the city.

METHODS

As outlined in previous publications, salmonella and shigella isolates^{1,2}

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TABLE I. NUMBER OF CASES OF MAJOR SALMONELLA SEROTYPES DIAGNOSED IN NEW YORK CITY, 1968-1977

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
<i>S. typhimurium</i>	369(37.1)	332(36.4)	227(22.2)	302(27.3)	244(24.4)	166(29.8)	120(22.1)	272(28.4)	385(32.2)	477(37.3)
<i>S. enteritidis</i>	111(11.2)	133(14.6)	182(19.8)	218(19.7)	129(12.9)	86(15.4)	70(12.9)	168(17.6)	210(17.6)	189(14.8)
<i>S. heidelberg</i>	75(7.6)	69(7.6)	95(9.3)	74(6.7)	35(3.5)	25(4.5)	21(3.9)	44(4.6)	75(6.3)	83(6.5)
<i>S. infantis</i>	38(3.8)	33(3.6)	32(3.1)	67(6.7)	67(3.7)	22(4.0)	25(4.6)	41(4.3)	38(3.2)	49(3.8)
<i>S. st. paul</i>	49(4.9)	58(6.4)	54(5.3)	38(3.4)	53(5.3)	39(7.0)	26(4.9)	32(3.4)	49(4.1)	32(2.5)
<i>S. newport</i>	87(8.7)	34(3.7)	47(4.6)	51(4.6)	85(8.5)	20(3.6)	15(2.8)	24(2.5)	23(1.9)	41(3.2)
<i>S. agona</i>	—	—	—	—	—	5(0.9)	36(6.6)	64(6.7)	77(6.4)	65(5.1)
<i>S. derby</i>	23(2.3)	18(1.9)	28(2.7)	25(2.3)	38(3.8)	29(5.2)	10(1.8)	28(2.9)	29(2.4)	29(2.3)
<i>S. thompson</i>	32(3.2)	39(4.3)	35(3.4)	22(2.0)	21(2.1)	6(1.1)	6(1.1)	6(0.6)	6(0.5)	8(0.6)
<i>S. blockley</i>	23(2.3)	22(2.4)	44(4.3)	53(4.8)	47(4.7)	20(3.6)	28(5.2)	19(2.0)	22(1.9)	25(2.0)
<i>S. reading</i>	1(0.1)	—	—	2(0.2)	3(0.3)	—	2(0.4)	6(0.6)	3(0.3)	11(0.9)
<i>S. oranienburg</i>	10(1.0)	18(1.9)	13(1.3)	8(0.7)	16(1.6)	13(2.3)	2(0.4)	10(1.1)	13(1.1)	17(1.3)
<i>S. manhattan</i>	10	16	17	22	20	6	17	7	14	5
<i>S. choleraesuis</i>	3	4	4	4	4	0	2	2	4	4
<i>S. schwarzengrund</i>	—	—	3	1	3	3	1	2	3	20
<i>S. kotibus</i>	—	—	3	2	2	1	0	18	13	0
<i>S. muenchen</i>	6	26	11	11	13	9	5	12	8	4
<i>S. london</i>	—	—	—	8	1	3	3	10	16	12
<i>S. ohio</i>	—	—	—	3	1	1	1	1	3	10
<i>S. reading</i>	1	1	—	2	3	—	2	6	3	11
Total	995(%)	913(%)	1022(%)	1105(%)	999(%)	557(%)	543(%)	955(%)	1194(%)	1278(%)

are reported to the Bureau of Preventable Disease of the New York City Department of Health by individual laboratories and by the Central Salmonella Serotyping Laboratory of the New York City Department of Health, Division of Laboratories. Until 1974 typing was also done at the Beth Israel Salmonella Typing Center. Records for 1968 to 1977 were reviewed and excerpts made from annual summaries prepared by the bureau. Similarly, the log books of the Bacteriology Laboratory of the Kings County Medical Center for 1974 to 1977 were reviewed and serotypes of the salmonella and shigella and their antibiotic resistance patterns tabulated.

RESULTS

Salmonella. The total annual individual cases of salmonellosis for 1968 to 1977 are reported in Table I. Repeated isolates from the same patient and out-of-city isolates are eliminated. During this 10-year period total cases have increased nearly 30%, although this has not been a steady rise. There is a marked trough in the number of cases reported for 1973 and 1974. It is doubtful that this decline was real, and it more probably resulted from closing the Beth Israel Salmonella Serotyping Center during those years and from a change in the reporting and tabulating procedures at the Bureau of Preventable Diseases. The Communicable Disease Center statistics³ on the number of salmonella isolates identified in the city, in contrast, offers no direct confirmation of any increase. Because each isolate is counted, not individual patients, and out-of-city cases sent for serotyping to New York City Laboratories are not excluded, numbers are usually greater than those of the Bureau of Preventable Diseases, yet they declined from 1,534 in 1968 to 1,286 in 1976. The national total of isolates itself declined during this period from 26,000 annually to 23,000, which itself has been attributed to loss of interest in the salmonella and decreased serotyping of isolates, and hence national reporting.³

In 1968 *S. typhimurium*, the most commonly isolated serotype, produced nearly 40% of all identified cases. Abruptly in 1970, *S. enteritidis*, the second most common serotype, increased to a 1971 peak of 20%, and then slowly decreased over the next several years. The increase was mainly at the expense of *S. typhimurium*, which again in 1977 regained its position with 40% of the total cases. Other common serotypes have generally fluctuated by a twofold factor from year to year, but show no consistent pattern, except for *S. thompson*, which is declining in frequen-

TABLE II. DISTRIBUTION OF SALMONELLA CASES BY GROUP AT KINGS COUNTY HOSPITAL

Group	1974	1975	1976	1977
B	51	81	87	117
C ₁	33	16	6	12
C ₂	22	11	13	8
D	46	48	66	50
E	14	5	12	5
F	—	—	—	1
G	1	—	1	—
Total	167	161	185	193

cy, and most notably *S. agona*, which was unknown in New York City before 1973, but which has produced about 70 cases a year over the last three years. Among the less common serotypes, *S. kottbus* appeared suddenly in 1970, peaked with 18 cases in 1975, but was not seen in 1977. Further down on the list, *S. london*, *S. ohio*, *S. reading*, and *S. schwarzengrund* have all for the first time reached 1% of the total during the past two years, just as *S. java* has fallen below it.

About 15% of salmonella cases in New York City are the contribution of Kings County Hospital. Therefore, the changes noted for the overall city cases are reflected there. Table II gives the cases by antigenic group. The increase in group B was due to *S. typhimurium*, which was noted in 80 cases (41%) in 1977. *S. agona* (part of this group) rose from eight cases in 1974 to 14 in 1977, and *S. schwarzengrund* produced one to two cases each year. In group C₁, *S. infantis* was the most common member, with three to 21 cases a year, while the highly pathogenic *S. choleraesuis* was isolated only twice during these four years. *S. thompson* was not seen after 1975 while *S. ohio* was isolated three times in 1977. Among group C₂ organisms, *S. newport*, *manhattan*, and *blockley* were the most frequent, but five *S. kottbus* cases were seen in 1975, the year of its peak for the city as a whole.

Group D contained the second most common salmonella, *S. enteritidis*, at 38 to 55 cases a year, and *S. typhi* was noted in eight cases during the four years. Among the other groups, *S. london* (Group E) was the most frequent.

Antibiotic resistance. Salmonella isolated from patients at Kings County Hospital during 1976 and 1977 show much less antibiotic resistance than

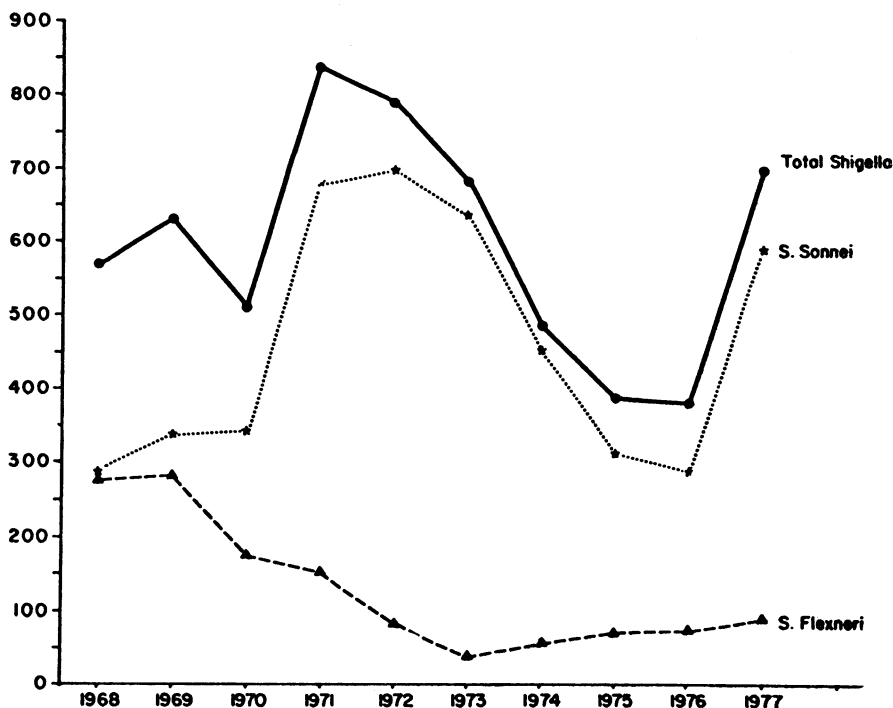


Fig. 1. Shigella cases reported to Bureau of Preventable Diseases, New York City 1968 to 1977, and the number of cases due to *S. sonnei* and *S. flexneri*. Despite the wide fluctuation in numbers of cases, the increased proportion of *S. sonnei* is evident.

the city as a whole had in previous years.¹ Figure 1 shows the decline from 1975 through 1977 in the total salmonella isolates for resistance to ampicillin and tetracycline. *S. typhimurium* and *S. heidelberg*, which had been the most resistant serotypes, showed only the same degree of resistance to ampicillin (4%), streptomycin (70%), and tetracycline (29%) as the rest of salmonella serotypes (Table III). The only difference noted between *S. typhimurium* and the other serotypes was minor: only 48% of the remaining serotypes were resistant to streptomycin, compared to 68% for *S. typhimurium*. Only one isolate (*S. westhampton*) was resistant to chloramphenicol over a two-year period.

Shigella. The number of cases of shigellosis reported to the bureau from 1968 to 1977 varied widely (Figure 2), but the increased proportion due to *S. sonnei* and the decreasing fraction due to *S. flexneri* has been consistent. All of the eight *S. dysenteriae* seen since 1975 have been imported cases.

TABLE III. ANTIBIOTIC RESISTANCE OF SALMONELLA AT KCH 1976 AND 1977

	Number	Ampi- cillin	Strepto- mycin	Tetracy- cline	Kana- mycin	Chloram- phenicol
<i>S. typhimurium</i>	82	4.2%	68%	28.5%	1.4	0%
Other salmonella serotypes	146	4.8%	47.5%	32%	2.9	9%

The high frequency of *S. sonnei* holds also for Kings County Hospital (Table IV), but the more than sixfold increase in shigella cases at that institution has been remarkable. Indeed, as of 1977, cases of shigellosis (186) nearly equalled cases of salmonellosis (193). In the early months of 1978 they exceeded them.

The antibiotic resistance data show a remarkable increase in ampicillin, tetracycline, and streptomycin resistance among *S. sonnei* (the major serotype) between 1975 and 1977, from 30% to 70%, while *S. flexneri* and *S. boydii* (minor serotypes) have remained sensitive generally. Consequently, the overall ampicillin resistance of the total shigella isolates has increased during the same period (Figure 3).

DISCUSSION

There was considerable interest in nontyphoid salmonella during the early 1960s when the CDC began to collect national statistics. Whether general interest stimulated data gathering and publication⁴ or collecting and publishing activities generated the interest can not be answered. The extraordinary *S. derby* institutional outbreaks of 1963 to 1964 clearly illustrated the important uses of serotyping salmonella and case reporting. The 18,640 human isolates reported in 1963⁴ represented a considerable increase over the previous year, i.e., before the special surveillance unit of the CDC was formed. The annual totals increased slowly to a peak of 26,693 in 1973 and have slowly declined since to 23,285 in 1976. The slowness of the changes and the erratic geographic localization are open to various interpretations but probably represent the limited availability of serotyping facilities and, of late, declining interest in salmonellosis.³ Meanwhile, the number of identified cases in New York City has grown considerably, although it fluctuates, again, for incompletely known reasons. A change in the methods of investigation and recording the reported

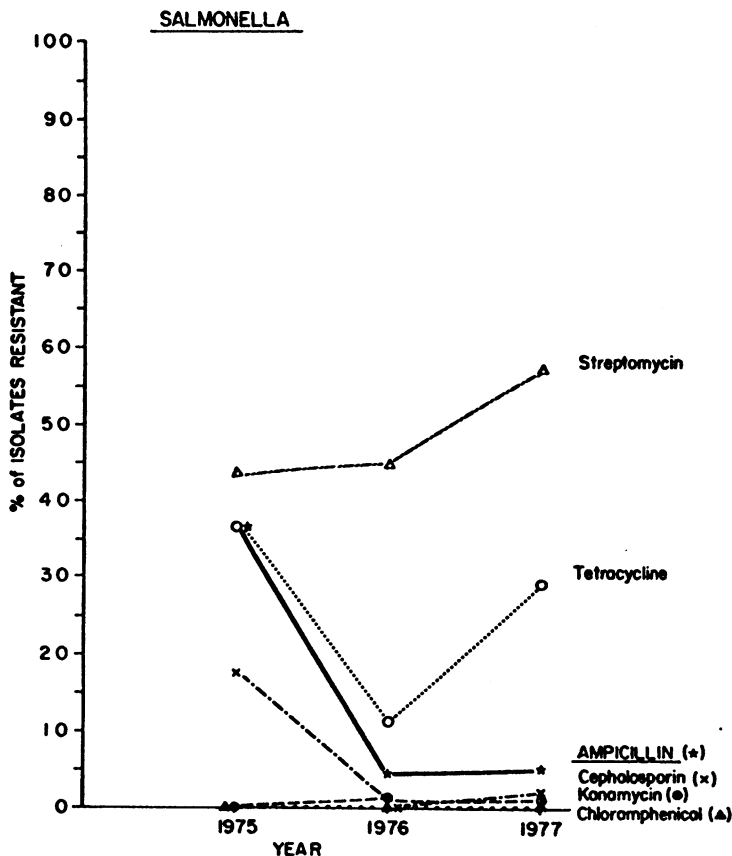


Fig. 2. Antibiotic resistance of salmonella showing the decline of ampicillin and tetracycline resistance in the salmonella isolated at Kings County Hospital 1975 through 1977.

cases is considered by the Bureau of Preventable Diseases to have been responsible. Overall, the vagaries of the serotyping and reporting system seem to be too great for reliable estimates of the total number of actual cases or to recognize any but large sudden shifts in the situation. Nevertheless, the number of cases in New York City is either stable or increasing slightly, but certainly not decreasing.

In contrast, the spectacular introduction in 1970 of *S. agona* into the United States, the sudden peaking of *S. kotbus* in 1975, and the rise of the rare *S. london* and *S. ohio* serotypes are clearly reflected in both New York City and CDC reports.³ The abrupt rise of *S. enteritidis* to the number two serotype in New York City during the early 1970s was not

TABLE IV. DISTRIBUTION OF SHIGELLA CASES OF KINGS COUNTY HOSPITAL

	1974	1975	1976	1977
<i>S.dysenteriae</i>	—	1	—	4
<i>S.flexneri</i>	9 (11.1%)	7 (20%)	7 (13.2%)	17 (9.1%)
<i>S.boydii</i>	—	—	—	3
<i>S.sonnei</i>	67 (88.9%)	27 (77.1%)	46 (86.8%)	162 (87.1%)
Total	76	35	53	186

matched on a national level. Although an increase was noted, this appears to be a regional phenomena.

Although rare and otherwise obscure salmonella serotypes have in the past produced large outbreaks, if not epidemics, through contaminated food, this does not seem to have been the case with *SS. agona*, *kottbus*, *london*, etc. The rise of these serotypes occurred over a period of years: cases are widely separated and show no consistent connecting factors between them. In particular, the *S. agona* (frequently showing antibiotic resistance), *S. kottbus*, and *S. schwarzengrund* cases have been investigated by the bureau and nothing has been identified to tie the cases together, although, as with all cases of salmonellosis, they were predominantly children from areas of poor housing within the city.

The antibiotic resistance of *S. typhimurium* and *S. heidelberg* increased during the past decade, especially resistance to ampicillin.¹ Surprisingly, this is not noted among the salmonella isolated at Kings County Hospital, which showed less resistance to ampicillin than previously reported.¹ No local variation in salmonella resistance has been noted before in New York City. A review of 200 salmonella isolates identified at Brooklyn Jewish Hospital and several hundred at St. Vincent's Hospital in Manhattan (courtesy of Dr. Pearl Ma), showed a similar low frequency of ampicillin resistance during 1976 and 1977. Telephone conversations with other hospital laboratories around the city revealed the same thing.

At the same time, ampicillin-resistant *S. sonnei* increased rapidly at Kings County Hospital between 1974 and 1977. This increase in New York City was reported previously,² but cephalothin resistance noted at Kings County Hospital among *S. sonnei* was not seen in the previous study.² The increasing proportion of *S. sonnei* and decreasing proportion of *S. flexneri* has been a feature in recent years of the eastern part of the country, as noted in CDC statistics,⁵ which also comment on increasing

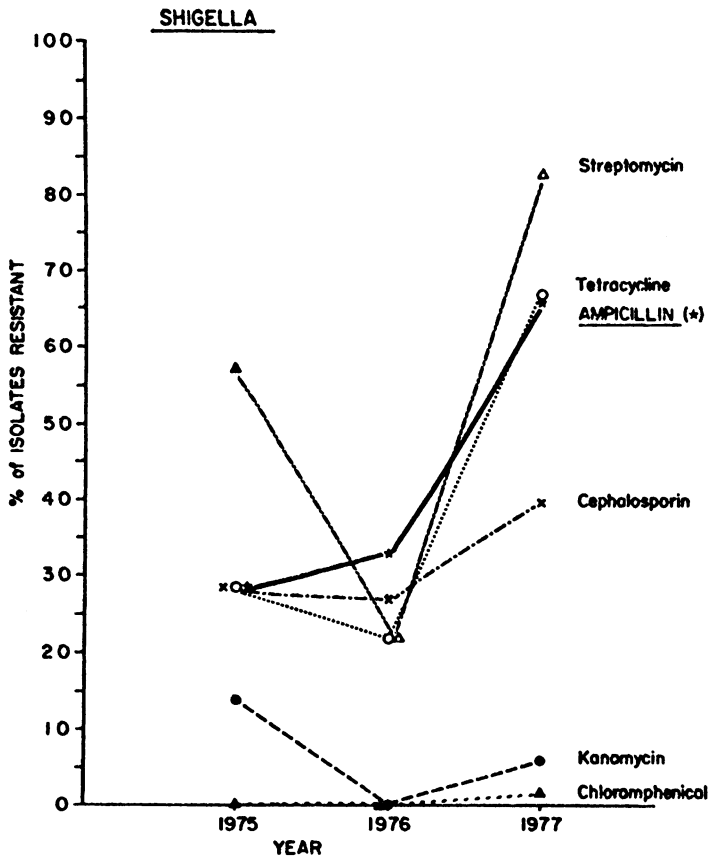


Fig. 3. Antibiotic resistance of shigella showing increase in ampicillin, tetracycline, and streptomycin resistance in the shigella isolated at Kings County Hospital 1975 to 1977.

isolations of shigella. However, the precipitous increase in cases at Kings County Hospital is unprecedented. The mode of isolation of the organism at the Kings County Hospital Bacteriology Laboratory was changed during this period to select a larger number of nonlactose-fermenting isolates from each stool sample for identification, and possibly this produced part if not all of the increased number of bacteriologically diagnosed cases. As of 1976, reports of shigellosis nationally were declining.⁵

Shigella are far more fragile organisms than salmonella, and, as a result are difficult to isolate from rectal swabs. They do not require elaborate serotyping by a central laboratory and hence are probably often misdiagnosed and therefore under-reported. In most parts of the world shigella is a

considerably more common intestinal pathogen than salmonella, except for the United States, where a one-to-three ratio of reported cases exists. That Kings County Hospital sees equal numbers of cases of each suggests either that our status as an exception is ending or that it never truly existed, but was an artifact of the relative inadequacy of our routine bacteriologic procedures.

SUMMARY

Reported cases of salmonella and shigella infection in New York City fluctuated widely between 1968 and 1977. Much of the variation might be attributed to changes in identification and in the reporting process. The trend in reported cases, however, is toward an increase, especially for the *Shigella sonnei* infections. These citywide trends in reporting of salmonella and shigella were paralleled by the data from the bacteriology laboratory of a large municipal hospital—Kings County Hospital. This suggests that the changes in serotypes of salmonella and shigella noted in the city data were real and not a bias of the reporting system.

Between 1975 and 1977 the percentage of *S. sonnei* strains at Kings County resistant to ampicillin has increased from 30% to 70%, while the percentage of *Salmonella* resistant to ampicillin has decreased from 37% to 5%. This change is apparently true for the city as a whole and is not easily explained by the influence of antibiotic usage.

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